

NON-PUBLIC?: N  
ACCESSION #: 8802040337

LICENSEE EVENT REPORT (LER)

FACILITY NAME: Waterford Steam Electric Station Unit 3 PAGE: 1 of 7

DOCKET NUMBER: 05000382

TITLE: Reactor Trip From Out-of-Range ASI Due To Inadequate Procedures  
EVENT DATE: 01/01/88 LER #: 88-001-00 REPORT DATE: 02/01/88

OPERATING MODE: 1 POWER LEVEL: 013

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR  
SECTION  
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:  
NAME: R. S. Starkey, Operations Superintendent  
TELEPHONE #: 504-464-3178

SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT: At 1327 hours on January 1, 1988, Waterford Electric Station Unit 3 was operating at approximately 13% power when the reactor tripped due to out-of-range Axial Shape Index (ASI). ASI, a measure of core power distribution, causes an auxiliary trip of the Core Protection Calculators (CPCs) if ASI is out of its allowed band and power is greater than approximately 17%. This condition occurs during a startup conducted before most of the xenon produced during previous operation has decayed. The enabling of this trip is based on raw excore detector signals, but operators were not previously aware of this fact. Operators were maintaining power at approximately 13 to 15% by compensated power indications when the Reactor tripped after a short withdrawal of Control Element Assemblies. This event is reportable as an automatic protective system actuation.

The root cause of this event was inadequate procedures since sufficient guidance is not provided for ASI control during reactor startup. Information on CPC monitored ASI at low powers has been disseminated. Procedures have been revised so that reactor power signals used by CPCs to determine ASI will be monitored, and allowable operating margins to the ASI and power limits provided. Since all protective features functioned as designed, there was no threat to the health and safety of the public or plant personnel.

(End of Abstract)

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At 1327 hours on January 1, 1988, Waterford Steam Electric Station Unit 3 was operating at approximately 13% power when the reactor tripped due to out-of-range Axial Shape Index (ASI). Operations personnel entered OP-902-000, "Emergency Entry Procedure," and plant conditions were stabilized in hot standby (Mode 3). Cycling of governor valves was in progress in preparation for rolling the Main Turbine (EIIS Identifier TA), and the Steam Bypass Control System (SBCS) (EIIS Identifier JI) was in use to remove primary heat. All Control Element Assemblies (CEAs) (EIIS Identifier AA-ROD) were fully withdrawn except Regulating Group 6 CEAs, which were at approximately 100 inches withdrawn. In order to establish the normal method of power control by boration and dilution with all rods withdrawn, a batch addition of boric acid was made to the Reactor Coolant System (RCS) (EIIS Identifier AB). Group 6 CEAs were then withdrawn in brief steps to compensate for the negative reactivity added by boration and maintain power constant. Approximately 30 seconds after one such withdrawal, the reactor tripped when low Departure from Nucleate Boiling Ratio (DNBR) and high Local Power Density (LPD) trips were received from the Core Protection Calculators (CPCs) (EIIS Identifier JC-CPU). These trips, without any pretrips, indicate an auxiliary trip of the CPCs, which was determined to be due to out-of-range ASI. This event is reportable as an automatic protective system actuation.

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ASI is a measure of the axial distribution of core power obtained by ratioing the difference over the sum of the lower and upper halves of core power. Below approximately 17% power, the CPCs use a fixed axial power distribution and ASI since there is a large margin to fuel design limits, and the excore neutron detectors (EIIS Identifier IG-DET) are not very accurate at low powers. The point at which the CPC switches from a fixed ASI to the actual ASI is known as the "switchover" point. The parameter which determines this point is a sum of the three uncompensated excore neutron detector subchannel readings stored in each respective CPC and known as "DKSUM." When DKSUM reaches 51%, which corresponds to approximately 17% core power, the CPCs switchover from the fixed ASI of -0.01 to the actual value of ASI. If ASI is out of its allowed band at the switchover, a reactor trip will occur. A level of 17% power is used to allow operation at a high enough power to burn out xenon expeditiously while maintaining power low enough to provide adequate margin to fuel design limits.

Just prior to the reactor trip, ASI was approximately -0.48, which is near

the lower end of its allowed band of -0.5 less than or equal to ASI less than or equal to +0.5. This was due to a buildup of xenon in the lower half of the core following a recent reactor shutdown, causing power during the startup to be concentrated in the upper half of the core. The withdrawal of CEAs causes ASI to become more negative. This apparently forced ASI below the lower bound of its allowed range in combination with a sufficient raw neutron flux signal to cause the ASI selection logic to switch over from the fixed ASI to the out-of-limit calculated ASI resulting in a reactor trip.

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The level of 51% in DKSUM corresponds roughly to a reactor power level of 17%; however, the actual axial power shape, RCS temperature, CEA positions and other factors can result in a DKSUM = 51% either above or below an actual core power of 17%. Since other indications of core power are not very accurate at low powers, and these other indications are compensated for rod shadowing, shape annealing, radial peaking, and other factors, the switchover point for ASI may be reached with indicated power levels less than 17%. This was the case in this event since the highest observed indicated power at the time of the trip was approximately 15% as indicated by the Channel A Calibrated Excore Power Recorder (EIIS Identifier IG-JR). Maintaining power at or below 15% until ASI was in range was in accordance with step 8.5.2 of OP-10-001, "General Plant Operations," the procedure used for reactor startup and power ascension.

Licensee Event Report (LER) 85-032 reported a reactor trip due to an out-of-range ASI caused by xenon buildup from an earlier trip. This occurred prior to modifications made to the CPCs during the first Refueling Outage. At the time of this event, ASI was not calculated by CPCs below 7% power, and there was no method provided to Operators to calculate ASI. Thus, there was no way to determine that the ASI was out-of-range until reactor power increased above 7%, at which time the CPCs tripped. A calculational method of ASI prediction was provided for Operators until modification during the Refuel Outage provided an addressable location in the CPCs which contains calculated ASI at low power.

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LER 86-025 reported a reactor trip due to an out-of-range ASI caused by a combination of high Steam Generator (SG) (EIIS Identifier AB-SG) levels which reduced SG steam volume, and an SBSCS malfunction which caused a rise in steam demand. A large buildup of xenon following a reactor trip had caused ASI to be out-of-range. Power was being maintained below the 7% ASI trip-enable setpoint to burnout xenon. SG levels had risen since it was difficult to control SG level at low powers. The small SG steam volume and SBSCS malfunction caused a large drop in steam pressure and rise in steam

demand, which raised reactor power above the 7% trip-enable power level. The SBCS equipment problem was repaired, and modifications made to the CPCs during the first Refueling Outage raised the ASI trip-enable setpoint to approximately 17% reactor power. It was thought that the higher power level would result in an acceptable ASI due to moderator temperature coefficient effects at these power levels.

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The above corrective actions were not adequate to prevent this event because the procedures and training which accompanied the CPC program changes did not provide sufficient information to allow operators to make intelligent risk management decisions in situations where it is desired to maintain power as high as possible to accelerate xenon burnout, while allowing sufficient margin to the setpoint which enables the ASI trip. There was no procedural guidance on the advisability of or methodology for ASI control below 20% power. Procedures also did not contain guidance on the advisability of reducing the absolute value of ASI using Part Length CEAs as soon as practicable during startup. The root cause of this event was therefore inadequate procedures. A contributing cause was inadequate training, since the operator would likely have monitored the raw excore signals had he been aware they were the decision parameters involved. On the subsequent reactor startup, Operations was limited to a power level of 10% until ASI was less negative than -0.4. Procedure OP-10-001 has been revised to include information on the proper indications to be monitored and allowable margins to the ASI and power limits. Information concerning the operation of the ASI trip-enable function was provided to the operating crews by inclusion in the Daily Instructions on January 8, 1988. This information will also be incorporated into the appropriate training lesson plan and presented to licensed operators during the 1988 training year.

The +/- 0.5 ASI auxiliary trip setpoints do not correspond to a safety limit or regions of unacceptable operation, but were selected as arbitrary limits to simplify CPC programming and analysis. Since the trip occurred with power and ASI at their lowest absolute values that would produce a trip, there was never an approach to any safety limit. Since a trip from 17% power is a relatively small transient and all safety systems functioned as designed, there was no safety significance to this event.

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#### SIMILAR EVENTS

LERs 85-032, 86-025

#### PLANT CONTACT

R.S. Starkey, Operations Superintendent, 504/464-3178

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Ref: 10CFR50.73(a)(2)(iv)

LOUISIANA POWER & LIGHT / WATERFORD 3 SES P.O. BOX B KILLONA, LA  
70066  
MIDDLE SOUTH  
UTILITIES SYSTEM

February 01, 1988

W3A88-0016  
A4.05  
QA

U.S. Nuclear Regulatory Commission  
ATTENTION: Document Control Desk  
Washington, D.C. 20555

SUBJECT: Waterford 3 SES  
Docket No. 50-382  
License No. NPF-38  
Reporting of Licensee Event Report

Attached is Licensee Event Report Number LER-88-001-00 for Waterford  
Steam Electric Station Unit 3. This report is submitted pursuant  
to 10CFR50.73(a)(2)(iv).

Very truly yours,  
/s/ N. S. Carns  
N. S. Carns  
Plant Manager - Nuclear

NSC/WEM:rk  
Attachment  
cc: R.D. Martin, NRC Resident Inspectors Office, INPO Records Center  
(J.T. Wheelock), E.L. Blake, W.M. Stevenson, J.H. Wilson

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